

### **Getting Started with CHP**

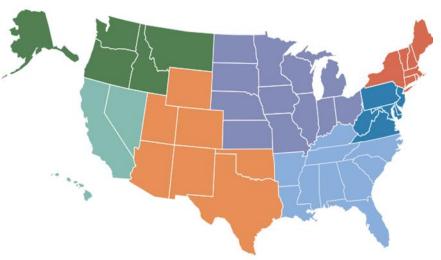
### **Cheryl Eakle**

Sustainability Engineer KPPC

### CHP Technical Assistance Partnerships

### **Key Activities**

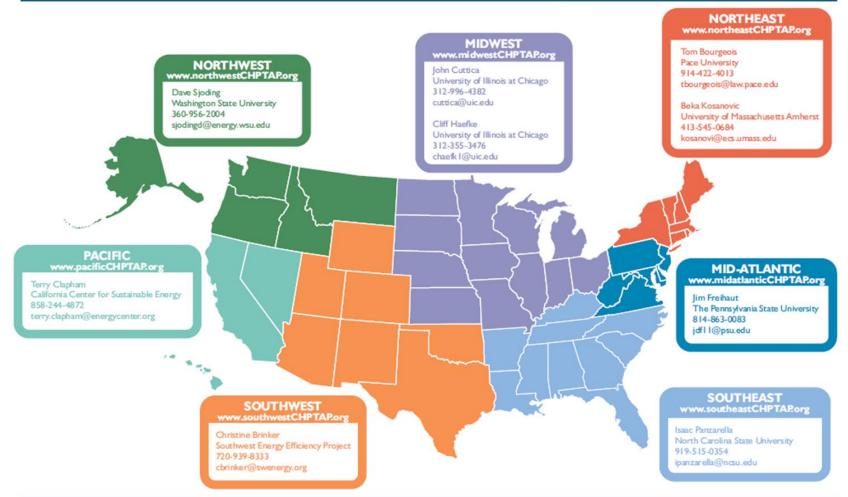
- Market Opportunity Analysis
   Supporting analyses of CHP market opportunities in diverse markets including industrial, federal, institutional, and commercial sectors
  - Education and Outreach
     Providing information on the energy and non-energy benefits and applications of CHP to state and local policy makers, regulators, end users, trade associations, and others.
- Providing technical assistance to endusers and stakeholders to help them consider CHP, waste heat to power, and/or district energy with CHP in their facility and to help them through the development process from initial CHP screening to installation.



http://eere.energy.gov/manufacturing/distributed energy/chptaps.html



#### **DOE CHP Technical Assistance Partnerships (CHP TAPs)**



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### Where to start?

# How can I determine if CHP is a good fit for my facility?



### CHP TAP Technical Development Assistance

Screening and Preliminary Analysis

Feasibility Analysis Investment Grade Analysis

Procurement, Operations, Maintenance, Commissioning



Quick screening questions with spreadsheet payback calculator.



Uses available site

information.
Estimate: savings,
Installation costs,
simple paybacks,
equipment sizing
and type.



3<sup>rd</sup> Party review of Engineering Analysis. Review equipment sizing and choices.



Review specifications and bids, Limited operational analysis





#### **Kentucky CHP TAP Qualification Screening**

#### Reciprocating Gas CHP System - no power export from site

#### **Facility Information**

Facility Name Hospital Location (City, State) Somewhere, KY Application n-Patient Care **Annual Hours of Operation** Annual Electricity Consumption (kWh) 16,061,600 Average Power Demand (MW) 1.83 Annual Fuel Consumption (MMBtu) 53,953.00 Annual Thermal Demand (MMBtu) 43,162.4 2012-2013 Actual Fuel Consumption times ~ 80% efficiency Average Thermal Demand (MMBtu/hr) 4.9 Average Electricity Costs (\$/kWh) \$0.065 2012-2013 Average Electricity cost \$5.030 Thermal Fuel Costs (\$/MMBtu) 2012-2013 Average Fuel cost CHP Fuel Costs (\$/MMBtu) \$5.030 Percent Electric Price Avoided 80%

#### **CHP System**

Net CHP Power (MW) 1.20 CHP Electric Efficiency, % (HHV) 38.0% 4,260 CHP Thermal Output (Btu/kWh) CHP Power to Heat Ratio 0.80 Calculated based on CHP power output and thermal output CHP Availability (%) 95% 90 to 98% Incremental O&M Costs (\$/kWh) \$0.010 Displaced Thermal Efficiency (%) 80.0% Displaced onsite thermal (boiler, heater, etc) efficiency Thermal Utilization (%) 100.0% Amount of available thermal captured and used - typically 80 to 100

Stand-by Electric Required? (1=Yes, 0=No) Required Standby Capacity (kW) Standby Charge (\$/kW)



### Effective Electric Cost

### **Effective Cost or "All-in Cost"**

Total Electric Bill (\$)
Total Electric Use (kWh)



#### Reciprocating Gas CHP System - no power export from site

#### **Facility Information**

**Facility Name** 

Location (City, State)

Application

Annual Hours of Operation

Annual Electricity Consumption (kWh)

Average Power Demand (MW)

Annual Fuel Consumption (MMBtu)

Annual Thermal Demand (MMBtu)

Average Thermal Demand (MMBtu/hr)

Average Electricity Costs (\$/kWh)

Thermal Fuel Costs (\$/MMBtu)

CHP Fuel Costs (\$/MMBtu)

Percent Electric Price Avoided

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omewhere, KY	
n-Patient Care	
8760	
15.051.500	
16,061,600	
1.83	
53,953.00	
43,162.4	2012-2013 A
4.9	

2012-2013 Actual Fuel Consumption times  $^{\sim}$  80% efficiency

\$0.065
\$5.030
\$5.030
80%

2012-2013 Average Electricity cost

2012-2013 Average Fuel cost



#### **CHP System**

Net CHP Power (MW)

CHP Electric Efficiency, % (HHV)

CHP Thermal Output (Btu/kWh)

CHP Power to Heat Ratio

CHP Availability (%)

Incremental O&M Costs (\$/kWh)

Displaced Thermal Efficiency (%)

Thermal Utilization (%)

Stand-by Electric Required? (1=Yes, 0=No)

Required Standby Capacity (kW)

Standby Charge (\$/kW)

1.20 38.0% 4,260 0.80 95% \$0.010 80.0%	
4,260 0.80 95% \$0.010 80.0%	 1.20
0.80 95% \$0.010 80.0%	38.0%
95% \$0.010 80.0%	4,260
\$0.010 80.0%	0.80
80.0%	95%
	\$0.010
100.0%	80.0%
100.0%	
	100.0%

O

Calculated based on CHP power output and thermal output 90 to 98%

Displaced onsite thermal (boiler, heater, etc) efficiency

Amount of available thermal captured and used - typically 80 to 100%



#### **Annual Energy Consumption**

Generated Electricity (kWh
Purchased Electricty (kWh)
CHP Thermal (MMBtu)
On-site Thermal (MMBtu)
Boiler Fuel (MMBtu)
CHP Fuel (MMBtu)
Total Fuel (MMBtu)

Base Case	
C	
16,061,600	۱
C	
43,162	
53,953	
0	۱
53,953	;

\$1,044,004

\$1,044,004

\$1,315,388

CHP Case
9,986,400
6,075,200
42,542
620
775
89,667
90,443

#### **Annual Operating Costs**

Purchased Electricity [Operating] (\$)	
Standby Electric Charges (\$)	
Total Electric Charges (\$)	
On-site Thermal Fuel (\$)	
CHP Fuel (\$)	
Incremental O&M (\$)	
Total Operating Costs (\$)	

\$524,711
\$0
\$524,711
\$3,900
\$451,027
\$99,864
 \$1,079,502

#### Simple Payback

Annual Operating Savings (\$)	\$235,
Installed Costs (\$/kW)	\$2,
Total Installed Costs (\$)	\$2,400,
Simple Payback, Years	1
•	

#### 0

Operating Costs to Generate	
Fuel Costs (\$/kWh)	\$0.045
Thermal Credit (\$/kWh)	(\$0.027
Incremental O&M (\$/kWh)	\$0.010
Total Operating Costs to Generate (\$/kWh)	\$0.028



#### **Annual Energy Consumption**

	Base Case	CHP Case
Generated Electricity (kWh)	O	9,986,400
Purchased Electricty (kWh)	16,061,600	6,075,200
CHP Thermal (MMBtu)	0	42,542
On-site Thermal (MMBtu)	43,162	620
Boiler Fuel (MMBtu)	53,953	775
CHP Fuel (MMBtu)	O	89,667
Total Fuel (MMBtu)	53,953	90,443

#### **Annual Operating Costs**

Aimaa Operating costs		
Purchased Electricity [Operating] (\$)	\$1,044,004	\$524,711
Standby Electric Charges (\$)	\$0	\$0
Total Electric Charges (\$)	\$1,044,004	\$524,711
On-site Thermal Fuel (\$)	\$271,384	\$3,900
CHP Fuel (\$)	\$0	\$451,027
Incremental O&M (\$)	<u>\$0</u>	<u>\$99,864</u>
Total Operating Costs (\$)	\$1,315,388	\$1,079,502



#### **Simple Payback**

Annual	Operating Savings	(\$)	)
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Installed Costs (\$/kW)

Total Installed Costs (\$)

**Simple Payback, Years** 

\$235,885
\$2,000
\$2,400,000
10.2

#### **Operating Costs to Generate**

Fuel Costs (\$/kWh)

Thermal Credit (\$/kWh)

Incremental O&M (\$/kWh)

<b>Total Operating</b>	Costs to	Generate	(\$/kWh)
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\$0.045
(\$0.027)
\$0.010

\$0.028



### Feasibility Analysis

## A DOE CHP TAP Feasibility Analysis usually involves:

- Baseline Energy Analysis
  - Electrical load profiling
  - Thermal load profiling
- CHP Equipment Selection and Sizing
   Matching technology to thermal needs, size, fuel availability, and unique requirements (duct firing, thermal, reliability considerations)
- Analysis Assumptions
   Energy Costs-electric rates and fuel prices
   CHP System Costs-installed equipment costs, O&M, interconnection



### Feasibility Analysis, continued

### Feasibility Analysis

- Facility Energy Profiles on baseline and CHP Options
- Economic Analysis operating savings, payback/IRR/ROI
- Sensitivity Analysis
- Emissions Analysis
- Recommended Next Steps



### Feasibility Analysis

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Estimate: savings, Installation costs, simple paybacks, equipment sizing and type.



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